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| APPLICATION NO.  | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO.   | CONFIRMATION NO. |
|--|-------------|----------------------|-----------------------|------------------|
| 10/585,229   | 04/20/2007  | Ismail Kashkoush     | ARK002-108430.040-US  | 9361             |
| 84212  | 7590        | 10/20/2010           |                       |                  |
| The Belles Group, P.C.<br>1518 Walnut Street<br>Suite 1706<br>Philadelphia, PA 19102 |             |                      | EXAMINER<br>VINH, LAN |                  |
|  |             |                      | ART UNIT              | PAPER NUMBER     |
|  |             |                      | 1713                  |                  |
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**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

|                              |                                      |   |  |
|------------------------------|--------------------------------------|---|--|
| <b>Office Action Summary</b> | <b>Application No.</b><br>10/585,229 | <b>Applicant(s)</b><br>KASHKOUSH ET AL. |  |
|                              | <b>Examiner</b><br>LAN VINH          | <b>Art Unit</b><br>1713                 |  |

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --**

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 04 October 2010.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-23 is/are pending in the application.
- 4a) Of the above claim(s) 13-21 and 23 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-12 and 22 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)            | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftperson's Patent Drawing Review (PTO-948)    | Paper No(s)/Mail Date. _____                                      |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>102506</u> .  | 6) <input type="checkbox"/> Other: _____                          |

**DETAILED ACTION**

***Election/Restrictions***

1. Applicant's election without traverse of Group I, claims 1-12, 22 in the reply filed on 10/4/2010 is acknowledged.

***Claim Rejections - 35 USC § 112***

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claim 22 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 22 recites the limitation "the mixture". There is insufficient antecedent basis for this limitation in the claim.

***Claim Rejections - 35 USC § 102***

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claim 22 is rejected under 35 U.S.C. 102(b) as being anticipated by Yokomizo et al (US 2002/010285)

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Yokomizo discloses a method to etch semiconductor wafers having a silicon oxide and silicon nitride layer ( page 2, paragraph 0028)

providing a closed-loop circulation system having a bath 11/process chamber and a recirculation line fluidly coupled to the process chamber (page 2, paragraph 0035)

supplying a predetermined volume of an etchant mixture to the closed-loop circulation system, the etchant filling the process chamber and overflowing into the recirculation line (page 2, paragraph 0034; page 4, paragraphs 0053-0054, fig. 1)

submerging at least one substrate in the etchant within the process chamber (page 3, paragraph 0048)

circulating the etchant mixture through the closed-loop circulation system ( page 3, paragraph 0049)

continuously measuring substance dissolving from a surfaces of wafer into the etching liquid (Si) /particle counts in the mixture with a detecting means/particle counter, ( page 3, paragraphs 0042, 0050)

upon detecting the etchant having a measured particle count above a predetermined particle count, automatically discharging/bleeding a volume of contaminated etchant from the closed-loop circulation system while replacing the volume by feeding fresh etchant into the closed-loop circulation system during the processing of the at least one substrate that will return the particle count of the etchant within the closed-loop circulation system to or below the predetermined particle count ( page 4, paragraphs 0058-0059)

***Claim Rejections - 35 USC § 103***

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-3, 4-8, 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yokomizo et al (US 2002/0102851) in view of Torek et al (US 6,087,273)

Yokomizo discloses a method to etch semiconductor wafers having a silicon oxide and silicon nitride layer ( page 2, paragraph 0028). The method comprises:

providing a closed-loop circulation system having a bath/process chamber 11 and a recirculation line 20 fluidly coupled to the bath/process chamber ( page 2, paragraph 0035)

supplying phosphoric acid, and water to the closed-loop circulation system in predetermined amounts so as to form a mixture having a predetermined concentration ratio and a predetermined volume ( page 4, paragraphs 0053-0054), the mixture filling the process chamber and overflowing into the recirculation line ( page 2, paragraph 0034; fig. 1)

submerging one substrate in the mixture within the process chamber ( page 3, paragraph 0048)

circulating the mixture through the closed-loop circulation system ( page 3, paragraph 0049), continuously measuring concentration ratio of the mixture with a concentration sensor ( page 3, paragraph 0042; page 4, paragraph 0052-0053)

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comparing the measured concentration ratio to the predetermined concentration value to determine whether the measured concentration value is within a predetermined range of the predetermined concentration ratio ( page 3, paragraph 0042)

upon determining that the measured concentration ratio is not within the predetermined range of the predetermined concentration ratio, automatically feeding a volume of phosphoric acid, and/or water into the closed-loop circulation system while discharging/bleeding a substantially equal volume of the mixture from the closed-loop circulation system that will return the concentration ratio of the mixture back within the predetermined range during processing of the at least one substrate ( page 4, paragraph 0058-0059)

Unlike the instant claimed invention as per claims 1, 7, Yokomizo fails to disclose supplying sulfuric acid, phosphoric acid and water to the circulation system wherein the predetermined concentration ratio is approximately 2 parts sulfuric acid, 2 parts phosphoric acid, and 1 part water

Torek discloses a process for etching silicon nitride using a mixture comprises sulfuric acid, phosphoric acid and water ( col 2, lines 25-28) wherein the predetermined concentration ratio is 30-50 % by volume of phosphoric, 20-40 % by volume of sulfuric acid and the balance water ( col 2, lines 27-30), which reads on approximately 2 parts sulfuric acid, 2 parts phosphoric acid, and 1 part water

Since Yokomizo is concerned with a method of etching SiN, one skilled in the art at the time the invention was made would have found it obvious to modify Yokomozo method by supplying an etching mixture comprising sulfuric acid, phosphoric acid and water to

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the circulation system as per Torek because Torek discloses that the etching mixture has greater selectivity than existing hot phosphoric acid etching processes and which maintains a high etch rate in use ( see abstract)

Regarding claims 2-3, the modified reference of Yokomizo would have disclosed that the etching mixture comprises sulfuric acid, phosphoric acid, and water are initially supplied to the process chamber via dispense lines 26, 42 ( fig. 1) and the mixture of sulfuric acid, phosphoric acid, and/or water are supplied via lines having control valves 25, 43 that can turn the flow of the fluid on and off ( fig. 1), which reads on the mixture of sulfuric acid, phosphoric acid, and/or water are supplied via spikes lines

Regarding claim 4, the modified reference of Yokomizo would have disclosed the step of heating the mixture prior to submerging the at least one wafer therein ( page 3, paragraph 0047)

Unlike the instant claimed inventions as per claims 5-6, Yokomizo fails to disclose the limitations of wherein the mixture is heated to a temperature at or near 160-180°C/ wherein the mixture is heated to a temperature at or near 165°C. Torek also discloses a step of heating the etching mixture to a preferred temperature of 140-180<sup>0</sup> C ( col 2, lines 20-24). One skilled in the art at the time the invention was made would have found it obvious to modify Yokomizo method by heating the etching mixture to a temperature of 140-180<sup>0</sup> as per Torek in order to effectively and efficiently etches SiN at a high etch rate as taught in Torek ( col 2, lines 33-36)

Regarding claim 8, the modified reference of Yokomizo would have disclosed the step of filtering the overflowed mixture through filter 23 ( page 2, paragraph 0038, fig. 1)

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Regarding claim 9, the modified reference of Yokomizo would have disclosed the steps of continuously measuring substance dissolving from a surfaces of wafer into the etching liquid (Si) /particle counts in the mixture with a detecting means/particle counter, comparing the measured particle count to a predetermined particle count to determine whether the measured particle count is greater than the predetermined particle count ( page 3, paragraphs 0042, 0050), upon detecting the mixture having a particle count that is greater than the predetermined particle count, automatically discharging/bleeding a volume of the mixture from the closed-loop circulation system and feeding a substantially equal volume of sulfuric acid, phosphoric acid, and/or water into the closed-loop circulation system that will return the particle count of the mixture back to or below the predetermined particle count during processing of the at least one substrate ( page 4, paragraphs 0058, 0059)

5. Claims 10-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yokomizo et al (US 2002/0102851) in view of Torek et al (US 6,087,273)

Yokomizo discloses a method to etch semiconductor wafers having a silicon oxide and silicon nitride layer (page 2, paragraph 0028). The method comprises:

supplying phosphoric acid, and water to a bath 11/process chamber in predetermined amounts so as to form a predetermined volume of mixture having a predetermined concentration ratio (page 4, paragraphs 0053-0054)

circulating the mixture through the process chamber in a closed-loop circulation system (page 3, paragraph 0049),



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submerging at least one substrate in the mixture within the bath/process chamber  
(page 3, paragraph 0048)

discharging a volume of mixture from the closed loop system so as to control the Si concentration in the circulating mixture ( page 4, paragraph 0059), which reads on bleeding a volume of mixture from the closed loop system so as to reduce the effect of etch-by-products in the circulating mixture

feeding phosphoric acid and/or water to replace the volume of mixture bled from the closed loop wherein the volume discharged/bled is selected to maintain or return the concentration ratio of the mixture to within a predetermined range of the predetermined concentration ratio ( page 4, paragraphs 0058-0059)

Unlike the instant claimed invention as per claim 10, Yokomizo fails to disclose supplying/feeding sulfuric acid, phosphoric acid and water to the circulation system

Torek discloses a process for etching silicon nitride using a mixture comprises sulfuric acid, phosphoric acid and water ( col 2, lines 25-28)

Since Yokomizo is concerned with a method of etching SiN, one skilled in the art at the time the invention was made would have found it obvious to modify Yokomozo method by supplying/feeding an etching mixture comprising sulfuric acid, phosphoric acid and water to the circulation system as per Torek because Torek discloses that the etching mixture has greater selectivity than existing hot phosphoric acid etching processes and which maintains a high etch rate in use ( see abstract)

Regarding claim 11, the modified reference of Yokomizo would have disclosed that the discharging/bleeding and feeding are performed continuously ( page 5, paragraph

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0066)

Regarding claim 12, the modified reference of Yokomizo would have disclosed the steps of continuously measuring the concentration ratio of the mixture with a concentration sensor during processing of the at least one substrate ( page 3, paragraph 0042; page 4, paragraph 0052-0053), comparing the measured concentration ratio to the predetermined concentration value to determine whether the measured concentration value is within a predetermined range of the predetermined concentration ratio; and upon determining that the measured concentration ratio is not within the predetermined range of the predetermined concentration ratio, automatically performing steps of discharging a volume of mixture from the closed loop system so as to control the Si concentration in the circulating mixture and feeding phosphoric acid and/or water to replace the volume of mixture bled from the closed loop ( page 4, paragraphs 0054; 0058-0059)

### ***Conclusion***

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to LAN VINH whose telephone number is (571)272-1471.

The examiner can normally be reached on M-F 8:30-5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 571 272 1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Lan Vinh/  
Primary Examiner, Art Unit 1713